Oxidation number method

* 1 Determine which atoms are being reduced and oxidized
* 2 Calculate the change in oxidation state between the reactant and products for both the reduction and oxidation
* 3 Calculate the coefficients that would be required to balance the charge
* 4 Balance H and O using H2O molecules

Half reaction method

* 1 Write separate half-reaction equations for oxidation and reduction.
* 2 Balance all elements except H and O
* 3 Balance O by adding H2O molecules.
* 4 Balance H by adding H+ ions
* 5 Balance charges by adding electrons.
* 6 Balance the electron
* 7 Add the half reactions

Problem Solutions

Ex 1

Cu(s)+ HNO3(aq)  Cu(NO3)2(aq) + NO(g)+ H2O(l)

1. Cu → Cu2+ and NO3- → NO
2. Already balanced
3. NO3- → NO+ + 2 H2O
4. NO3- + 4 H+ → NO + 2 H2O
5. NO3- + 4 H+ + 3e- → NO + 2 H2O and Cu → Cu2+ + 2e-
6. 2(NO3- + 4 H+ + 3e- → NO + 2 H2O) and 3 (Cu → Cu2+ + 2e-)
7. **3Cu + 2** **NO3-** + **8 H+ → 4 H2O + 3Cu2+ + 2 NO**

Ex 2

MnO4-(aq) + Fe2+(aq) + H+(aq) → Mn2+(aq) + Fe3+(aq) + H2O(l)

1. MnO4- → Mn2+ and Fe2+ → Fe3+
2. Already balanced
3. MnO4- → Mn2+ + 4 H2O
4. MnO4- + 8 H+ → Mn2+ + 4 H2O
5. MnO4- + 8 H+ + 5e- → Mn2+ + 4 H2O and Fe2+ → Fe3+ + 1e-
6. MnO4- + 8 H+ + 5e- → Mn2+ + 4 H2O and 5(Fe2+ → Fe3+ + 1e-)
7. **MnO4- + 8 H+ + Fe2+ → 5 H2O + Mn2+ + 5 Fe3+**

Ex 3

Cr2O72−(aq) + HNO2(aq)   Cr3+(aq)+ NO3−(aq)

3(H2O + HNO2 🡪 NO3- + 3 H+ + 2 e-), 6 e- + 14 H+ + (Cr2O7)2- 🡪 3NO3 + 2 Cr3+ +4H2O

**3(HNO2) + 5 H+ (Cr2O7)2- 🡪 3NO3 + 2 Cr3+ + 4H2O**

Ex 4

Mn2+(aq) + NaBiO3(s) → Bi3+(aq) + MnO4-(aq)

**2Mn2+ + 5NaBiO3 + 14 H+ 🡪 2MnO4 + 5 Bi3+ + 5 Na+ + 7 H2O**